Pneumatic spindle with means to direct the bearing air towards the tool-holding collet

The present invention relates to machine tools, and more especially those designed to drill holes at very high speeds of rotation of the tool (even exceeding 100,000 revolutions per minute).

More specifically, the invention is concerned with machine tools in which, to prevent friction between the spindle casing and the rotating parts fixed to the tool, aerostatic bushes, known to those skilled in the art, are interposed between the two. In aerostatic bushes the rotating parts are supported by cushions of air generated in the air gaps by the continuous feeding in of a jet of air which, after having travelled through the said air gaps performing its bearing function as described, passes out of the spindle through the same aperture formed in a flange mounted on the free end of the spindle, as that through which the tool-holding collet projects.

In the high-speed drilling work mentioned above, and especially where the holes are being made in materials of low specific weight such as the resins for printed circuit boards, a fine dust is thrown up, consisting of the minute chips that are generated, which is deposited in the radial slits formed in the end of the tool-holding collet to enable it to be opened and closed around a tool. This necessitates cyclical cleaning and maintenance operations, which, in view of the large total number of spindles usually used in a plant and the frequency of the drilling operations, represents a significant addition to production costs. The reason for this is that although the aforementioned jet of air passes out through the said aperture parallel to the tool-holding collet, it is then deflected by vortices generated by the very high-speed movement of the edges

and sides of the collet and begins to move in a direction which has a large radial component leading away from the said collet. It cannot therefore exert any action that would keep the said fine dust away from the abovementioned radial slits.

In other words, in front of the end of the collet, a zone is generated in which the air is effectively stagnant, allowing the granules of the said fine dust to pass through it and reach and be deposited in the abovementioned slits.

The inventor of the present invention felt that this problem could be avoided if the abovementioned jet of air could be directed by suitable means to keep it alongside the tool-holding collet, before it comes away from it in a tangential direction roughly parallel to the axis of the spindle.

For this purpose he has devised the spindle according to the invention, in which directing means are attached to its flange, through which the tool-holding collet projects, which means collect the said jet of air and channel it into a direction that is tangential to or incident on the terminal part of the said tool-holding collet containing the said slits. The jet of air thus keeps the fine chip dust away from the slits, thereby achieving the object of keeping them clean.

The subject of the present invention is therefore a spindle as described in the appended Claim 1.

A more detailed description will now be given of a preferred illustrative embodiment of a spindle according to the invention. This embodiment is selected from the many embodiments available to those skilled in the art in keeping with the teachings of the abovementioned Claim 1.

In the course of the description, reference will also be made to the attached drawings, which show:

- in Figure 1, a longitudinal section through a spindle with aerostatic bushes in accordance with the prior art; and
- in Figure 2, a longitudinal section through a spindle with aerostatic bushes in accordance with the invention.

Referring to Figure 1, this shows that, in a spindle 10 in accordance with the prior art, the moving part 2, which is integral with the tool-holding collet 3 in its rotations R, is supported by two aerostatic bushes 4 via two cushions of air generated by known methods by a jet of compressed air flowing continuously (arrows D) through the air gaps 5 between the aerostatic bushes 4 and the said moving part 2. This jet of air then passes out of the spindle 10 through a co-axial aperture 6 formed in a flange 7 through which the tool-holding collet 3 protrudes from the casing 10c of the spindle 10. As can be seen in the drawing, after passing through the aperture 6, the abovementioned jet of air adopts a direction (again indicated by the arrows D) that has a significant radial component causing it to move away from the terminal part of the tool-holding collet 3 and its radial slit 3t. The jet of air cannot therefore exert any action that would keep the fine chip dust (not shown) away from the slits.

Figure 2, on the other hand, shows a spindle 1 according to the invention, similar in type to that described earlier, and having the same component parts, namely a casing 1c and two aerostatic bushes 3 which support as illustrated the moving part 2 which is integral in its rotations R with a tool-holding collet 3 containing the said radial slits 3t. In the spindle 1 according to the invention, however, directing means, consisting here of a cap 8, are attached co-axially to

the outside of the flange 7 (which is similar to that described in the previous case). These directing means collect the said jet of air (the direction of which is indicated this time by the letter E) and channel is tangentially to or in a slightly incident manner on the terminal part of the tool-holding collet 3 containing the abovementioned radial slits 3t, which collet projects out of the cap 8 to at least some degree, sufficient for its opening up to release the tool (not shown) not to be obstructed by the presence of the cap 8.

As seen in Figure 2, as the jet of air passes out through the gap between the cap 8 and the tool-holding collet 3, it maintains a direction E that is tangential to or slightly incident on the terminal part of the collet containing the said radial slits 3t, thus preventing fine chip dust getting into the slits and being deposited in them.

The object addressed by the inventor has therefore been achieved. This object can also be achieved by using components (such as the cap 8, for example) that differ in shape and position from those described above and shown in Figure 2.